



## ***Bacillus thuringiensis* var. *israelensis* (Bti)**

November 2004

### **Introduction to Biopesticides Registered for Mosquito Control**

*Bacillus thuringiensis* var *israelensis* (Bti), *Bacillus sphaericus* and [methoprene](#) are three biopesticides that may be applied to standing water and other breeding sites (e.g. stormwater retention areas, ditches, or ponds) for the purpose of selectively reducing populations of mosquito



larvae when source reduction strategies are not working. [Biopesticides](#) include products derived from naturally occurring bacteria and insect growth regulators (IGRs). Mosquito larvae are immature mosquitoes or “wigglers” that hatch from eggs laid in masses by female mosquitoes on or around the edges of surface water. Bti is a subspecies of

*Bacillus thuringiensis* (Bt) that has been used worldwide as a biological pesticide since 1980 for mosquito control. Bti was registered by EPA in 1983 and has been used as a Best Management Practice (BMP) option to manage the larval stage of feeding mosquitoes before they become adults and bite people.

### **How is Bti regulated in Washington?**

Distribution and use of Bti and other pesticides in Washington are subject to compliance with federal and state regulations including the Washington Pesticide Control Act ([15.58 RCW](#)), the Washington Pesticide Application Act ([17.21 RCW](#)), and General Pesticide Rules ([WAC 16-228](#)). Many of the larvicides are registered by WSDA as [state restricted use pesticides](#) (as opposed to Home and Garden products) and may require a National Pollutant Discharge Elimination System (NPDES) permit before making an application according to established practices. Visit the Washington State Department of Health’s (DOH) web page for the most recent information on West Nile virus and answers to common questions about Bti. Permitting information is available from the [Washington State Department of Ecology](#), DOH and [local health departments](#).

### **Which Bti products are registered?**

Washington State Department of Agriculture (WSDA) and WSU provide guidance on Bti and other [larvicides registered](#) for control of mosquito. Product selection may be based on the species, life stage, habitat, population, temperature, non-target impacts, resistance management, and cost. Some species, such as *Anopheles* and *Culex*, may require the higher labeled rates to achieve acceptable control. Bti products are formulated as liquid spray, granular and dust. The granular forms are useful against mosquito larvae (e.g. *Culex* spp.) found in used tires and other artificial containers. *B. sphaericus* may be a better choice than Bti when targeting larvae in turbid water with high organic content (e.g. animal waste lagoons). Refer to WSU’s publications, “Pest Management for [Prevention and Control of Mosquitoes](#)” and “[Pesticide Regulations on use of Mosquito Larvicides](#)”, for more information on Bti.

### **WEST NILE VIRUS INFORMATION :**

#### **Pesticide Registration**

- Wendy Sue Wheeler, Aquatic Pesticides 360.902.1972
- Steve Foss, Biopesticides 360.902.2049
- Shannon Lumsden, Home & Garden Products 360.902.2032

<http://agr.wa.gov/PestFert>

#### **Pesticide Licensing**

Many people who use, sell or consult on the use of pesticides are required to be licensed by the Washington State Department of Agriculture (WSDA). This requirement does not generally apply to homeowners who use home and garden pesticides on their own property. To learn more about licensing for mosquito control, go to the fact sheet [Pesticide Licensing for Professional Mosquito Control](#).

#### **Licensing Question?**

Contact us toll-free at (877) 301-4555 or by e-mail at [license@agr.wa.gov](mailto:license@agr.wa.gov)

#### **WSU Pesticide Safety Education**

This program provides training and study manuals for WSDA exams.

Pesticide Education Web site is <http://pep.wsu.edu>

**ALWAYS READ  
AND FOLLOW THE  
LABEL**



## How does Bti work?

Mosquito larvae must eat the Bti-formulated product containing dormant bacterial spores. Crystals, which are known as Insecticidal Crystal Proteins (ICP) or delta-endotoxin, are produced during Bti sporulation. The mosquito larvae stop feeding and die when these proteins are converted into toxins that work by damaging the gut wall of mosquitoes. This reaction cannot take place in humans and other mammals. Bti is a single brood product that is effective against the early stages of mosquito larvae and does not affect mosquito eggs, mature larvae, pupae, or adults. The length of effectiveness can vary between formulations and environmental conditions. More information on the mosquito life cycle may be found on [WSU's](#) and the US Environmental Protection Agency's ([EPA's](#)) web pages.



Electron Micrograph of a Sporulating Bt Cell

## What are some benefits of using Bti?

Bti effectively controls mosquitoes, is inherently less toxic than conventional pesticides, and has relatively minimal impact upon most non-target organisms. According to EPA, the toxicology of Bti is well-established and exhibits minimal to nonexistent risk to humans, pets, birds, aquatic organisms (e.g. fish and invertebrates), non-target plants and honey bees. Bti is one of two biological pesticides that may be applied for mosquito control in certain sensitive sites in Washington due to its increased margin of safety. EPA reports that the use of biopesticides can reduce the use of other pesticides (e.g. adulticides) when used as part of an IPM program. Refer to [DOH's](#) for answers to common health-related questions on Bti or EPA's [Biopesticide](#) web site for other advantages of using Bti.

## When should Bti be used?

Mosquito (larval and adult) and bird-based surveillance, historical records (dates of previous treatment), mapping, experience, and current temperature and wind conditions are useful in determining when to apply Bti. Pesticide applicators with [Mosquito Control Districts](#) in Washington State systematically monitor field reference sites to determine when applications are necessary. These licensed and trained applicators follow uniform treatment standards before applying Bti in accordance with world standards that comply with federal pesticide (EPA) and other state regulations. They may use counts from traps (e.g. light or CO<sub>2</sub>-baited Encephalitis Vector Survey) as timing-indicators for treating potential problem areas with pesticides. The Center for Disease Control (CDC) recommends alternating [biorational larvicides](#) and IGRs annually or at longer intervals to prevent the onset of pesticide resistance. Once WNV vector mosquitoes have been positively identified in an area, control treatments are warranted, especially around high-risk populations.

## References

- Antonelli A., T. Murray, and C. Daniels. 2003. Pest Management for Prevention and Control of Mosquitoes with Special Attention to West Nile Virus. WSU-Puyallup PLS-121.
- US EPA Reregistration Eligibility Decision (RED): [Bacillus thuringiensis](#). March 1998. EPA Publication Number EPA738-R-98-004.
- Bajwa, W.I. and M. Kogan. [Bacillus thuringiensis](#) - Based Biological Control of Insect Pests. Integrated Plant Protection Center (IPPC), Oregon State University, Corvallis. June 2001.
- Lacey, L.A. and R. W. Merritt. 2003. [The Safety of Bacterial Microbial Agents](#) used for Black Fly and Mosquito Control in Aquatic Environments. *In: Environmental Impacts of Microbial Insecticides: Need and Methods for Risk Assessment.* (H. M. T. Hokkanen and A. E. Hajek, eds.), pp. 151-168. Kluwer Academic Publishers Dordrecht, The Netherlands.
- Platt, T. and C. Ramsay. Pesticide Regulations on Use of Mosquito Larvicides. July 2004.
- Ramsay, C. and M. Tucker. 2002. Pesticide Licensing for Professional Mosquito Control.
- Washington State Department of Ecology. Best Management Practices for Mosquito Control. Ecology publication #03-10-023. May 2004.